Estimating the Economic Impacts of Climate Change on California Agriculture

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Public Interest Energy Research Program

Sacramento, September 10 2009

Overview

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  - Climate Change Impacts through water and land
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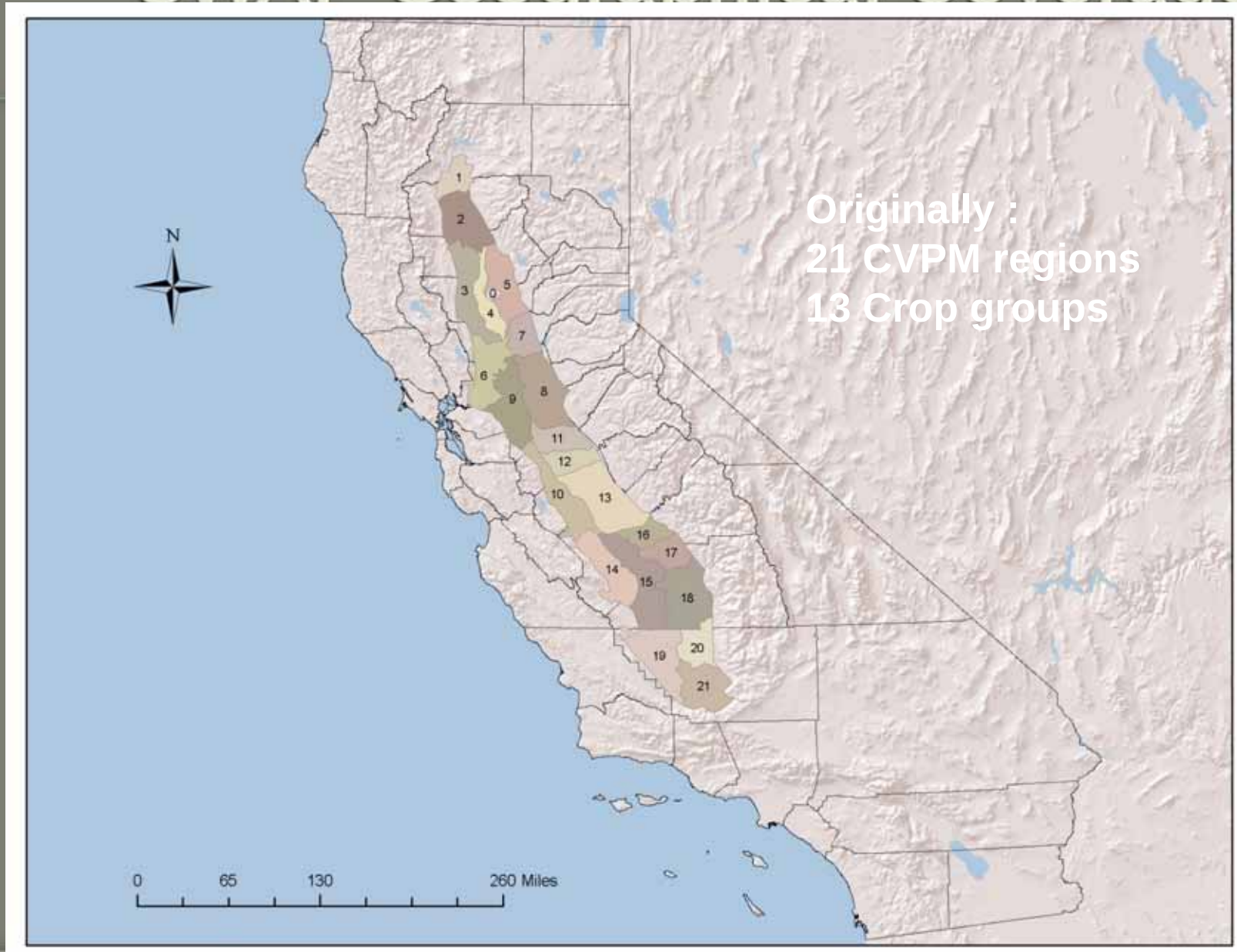
Introduction

- Value of Agriculture in California
- Land cropping patterns are influenced by
  - Economic factors
  - Geographic conditions
  - Climatic conditions
- Future of California agriculture
  - Interaction among:
    - Technology
    - Resources
    - Market demands

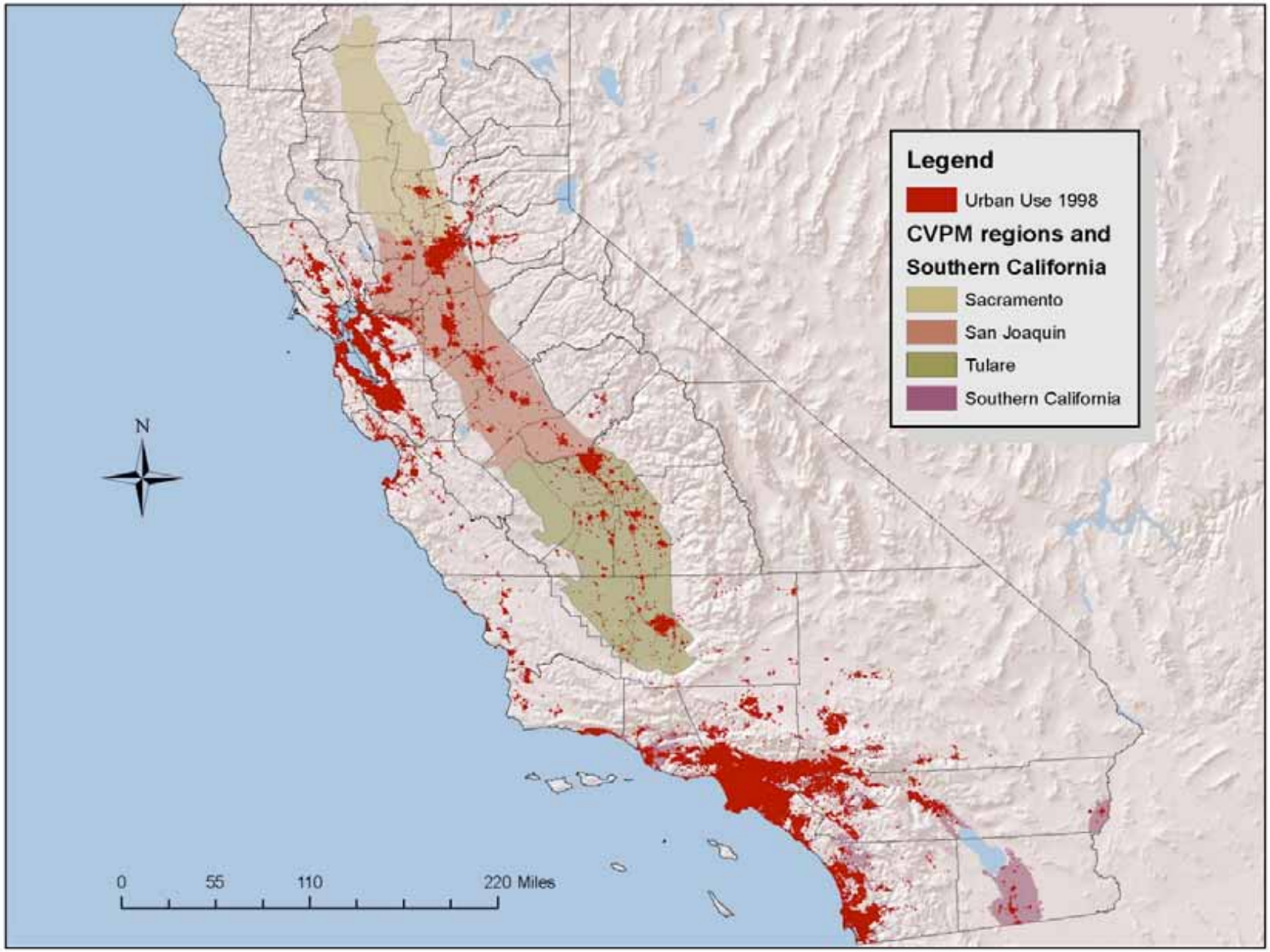
The Statewide Agricultural Production Model (SWAP)

- Farmers are assumed:
  - Rational
  - Aimed to maximize profits
- Three step self-calibrating model
- Dairy herd feed is included
- Inputs: water, labor, land, supplies, 2000-05
- Thirteen Crop groups
- Two climate scenarios analyzed 2050
  - Historical
  - Warm-Dry

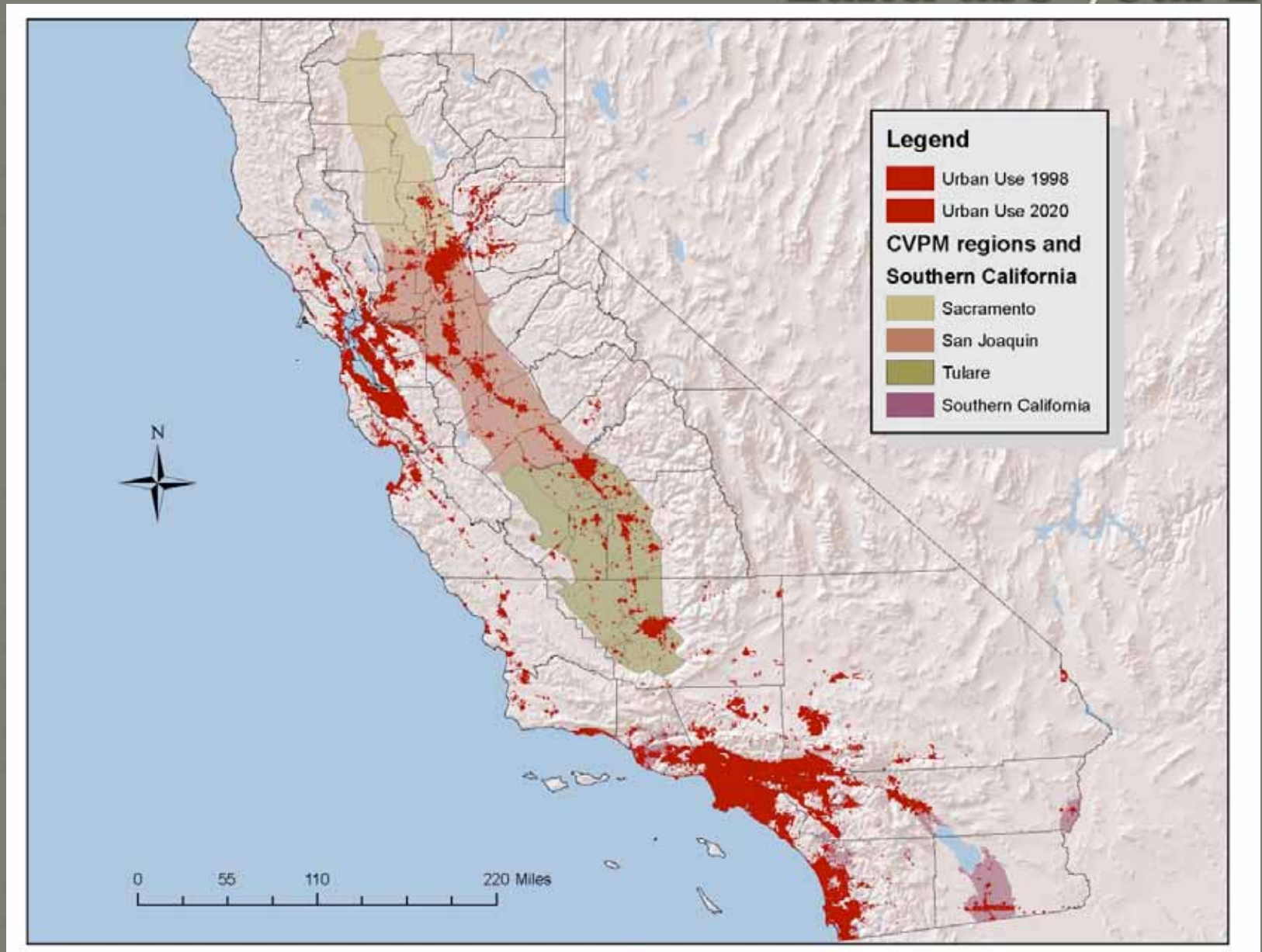
SWAP Geographical Coverage



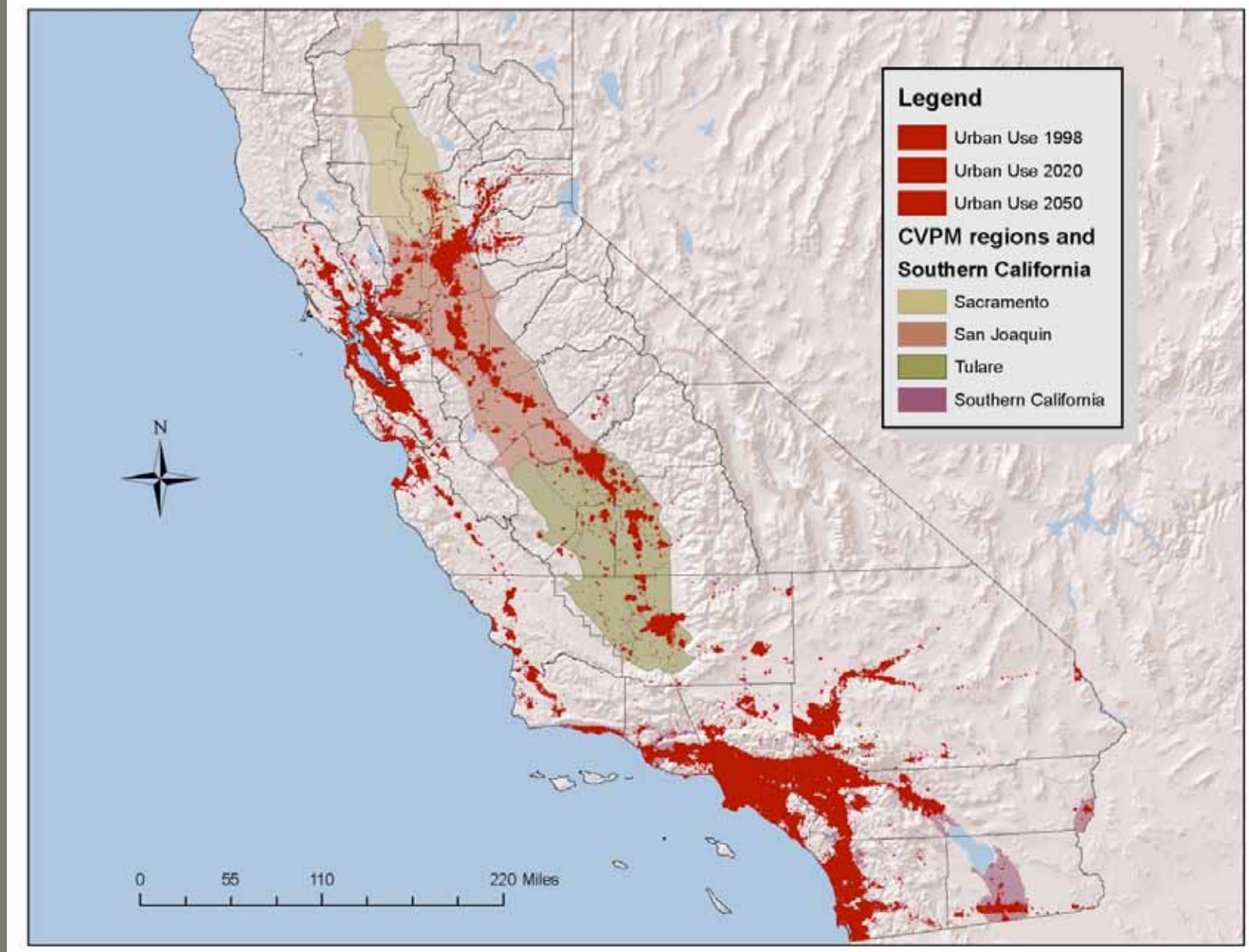
Land use year 1998



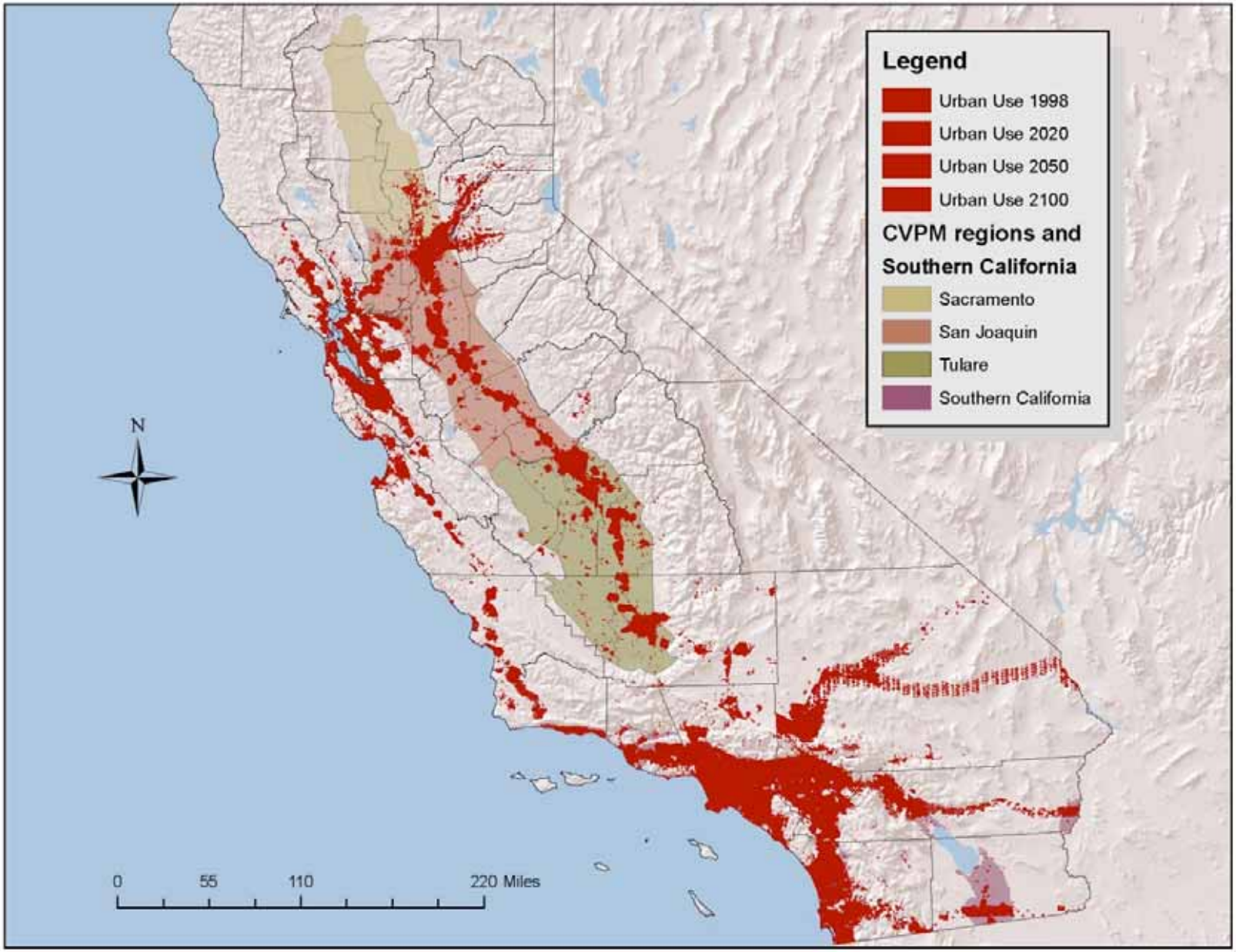
Land use year 2020



Land use year 2050



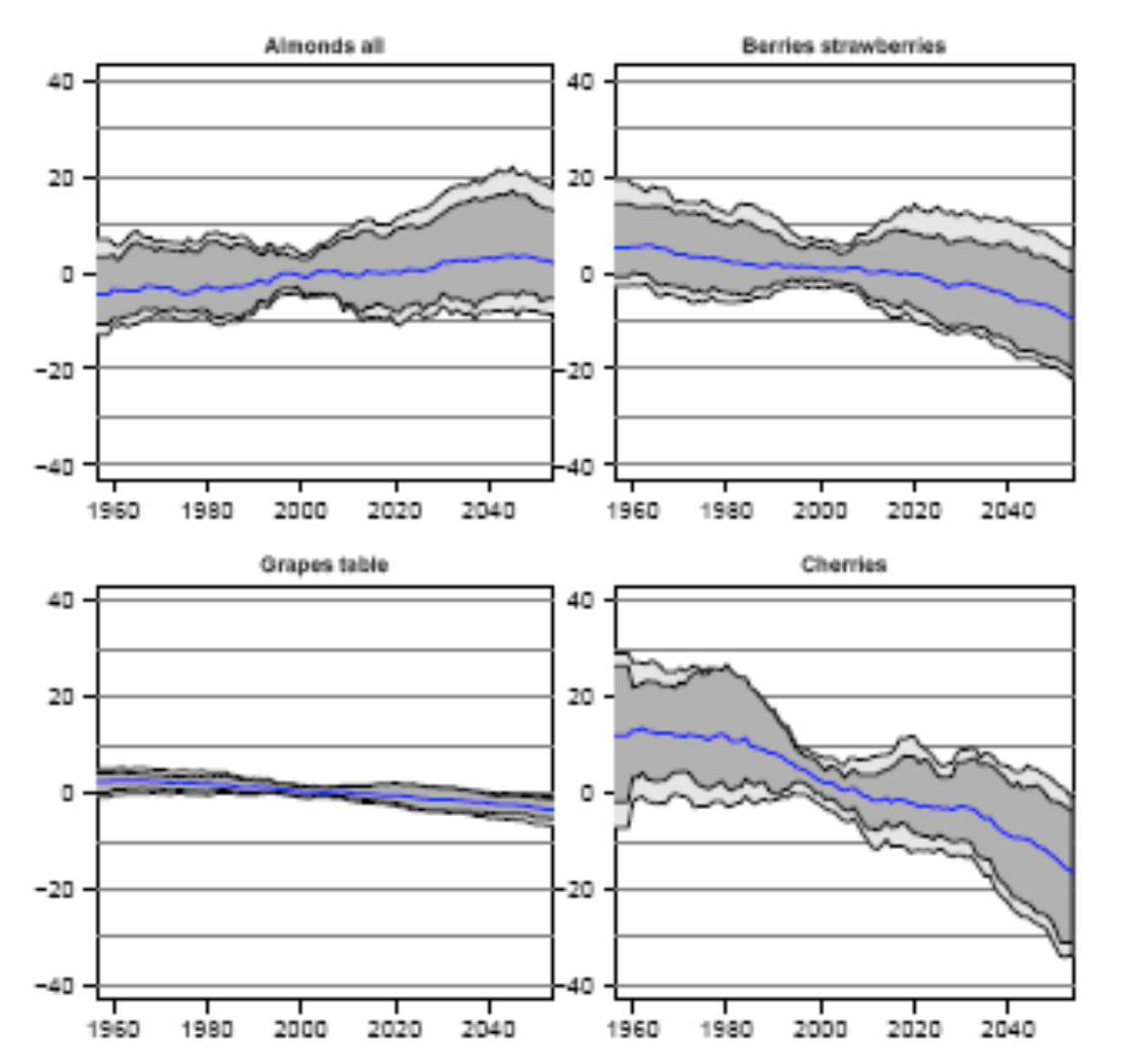
Land use year 2100



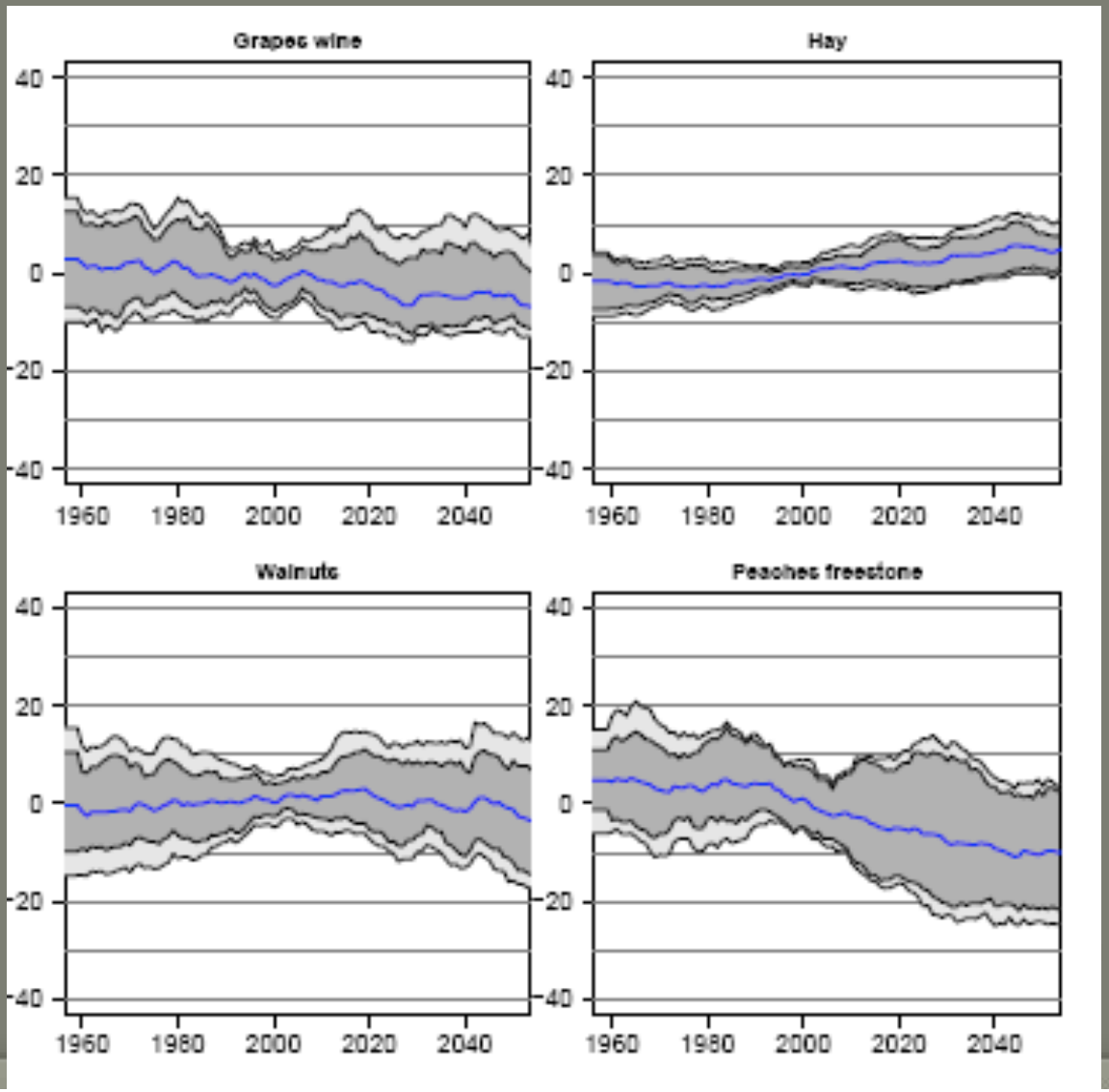
Technological Change and Crop Demands by 2050

Crop	Yield % Change Technology	Demand % Change Intercept
Alfalfa*	29.1	3.3
Citrus	28.5	3.6
Corn	25.4	5.7
Cotton	29.1	2.1
Field	29.1	3.3
Grains	29.1	7.6
Grapes	23.4	16.4
Orchards	36.4	3.8
Rice	31.9	-4.1
Tomato	40.1	26.9
Truck	25.4	45.5

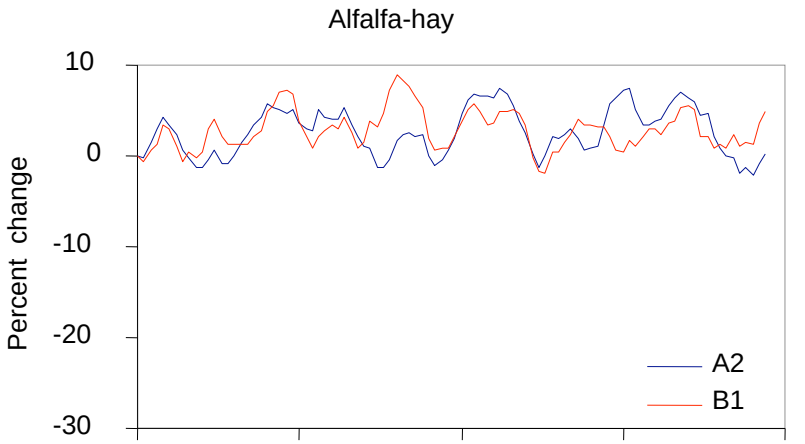
California Perennial Crops (Lobell et al.)

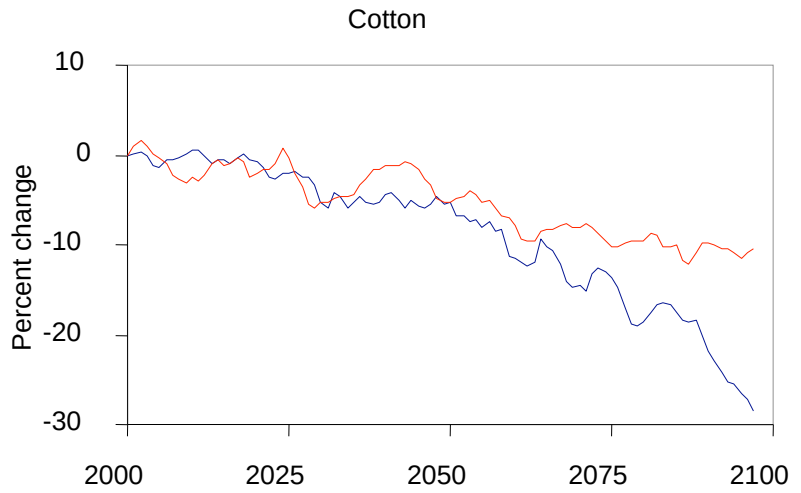


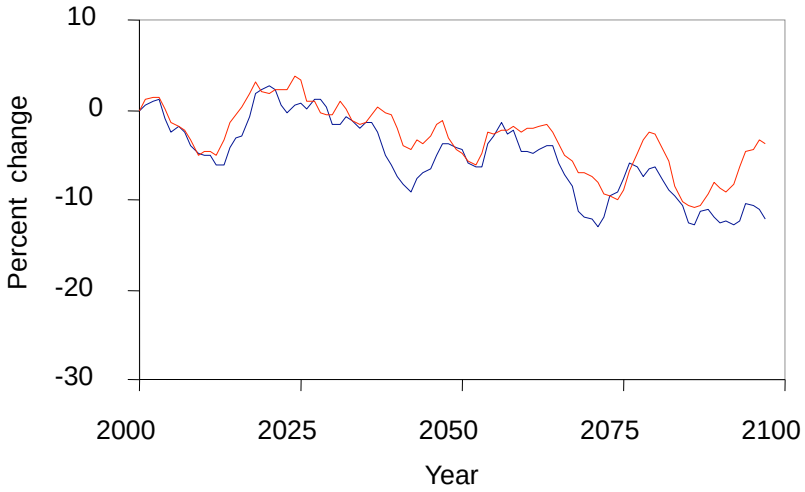
Perennial Crops… continued

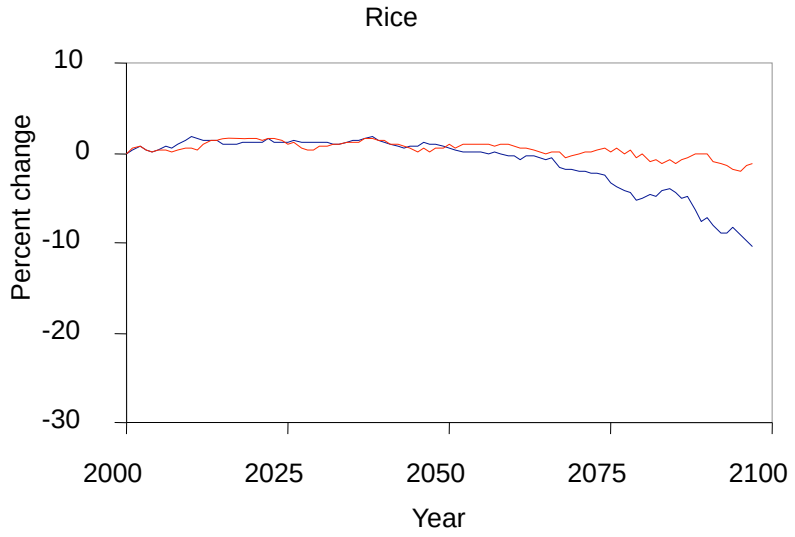


Lee, De Gyrze and Six



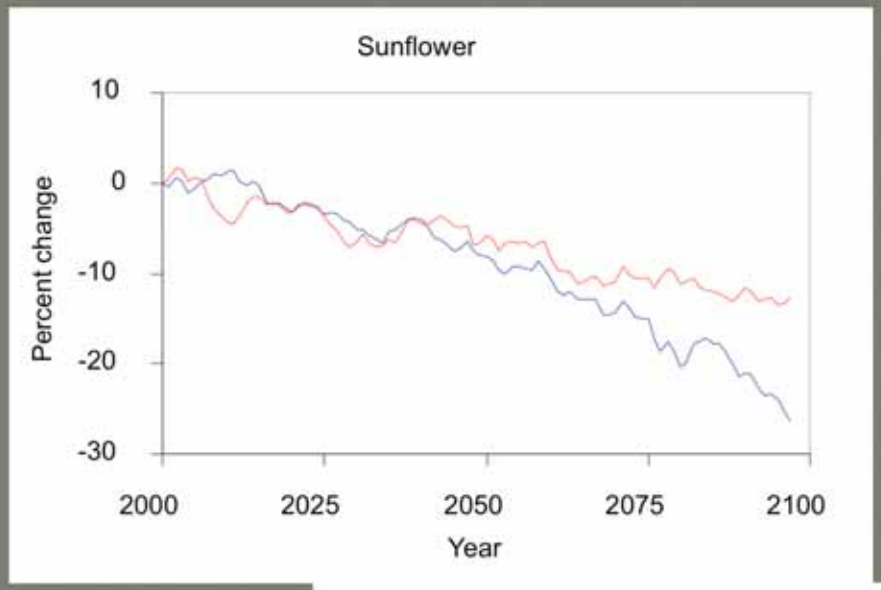


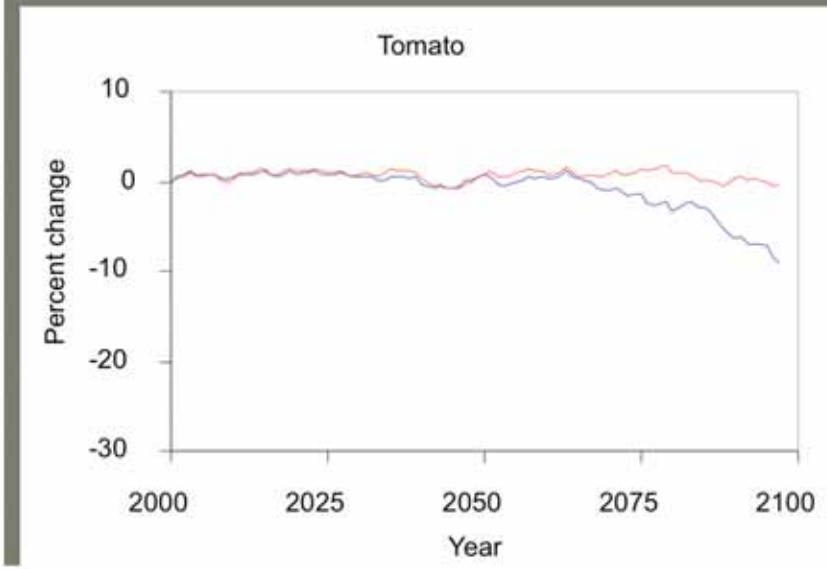


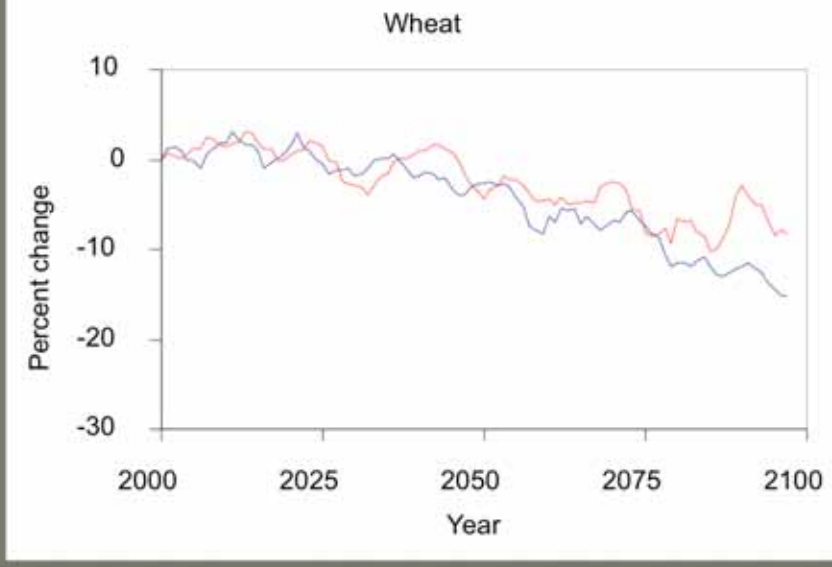


Red is low emissions (B1) Blue is high emissions (A2)

Lee, De Gyrze and Six







Red is low emissions (B1)
Blue is high emissions (A2)

Climate Change Model Innovations

- Water Availability (feedback from CALVIN)

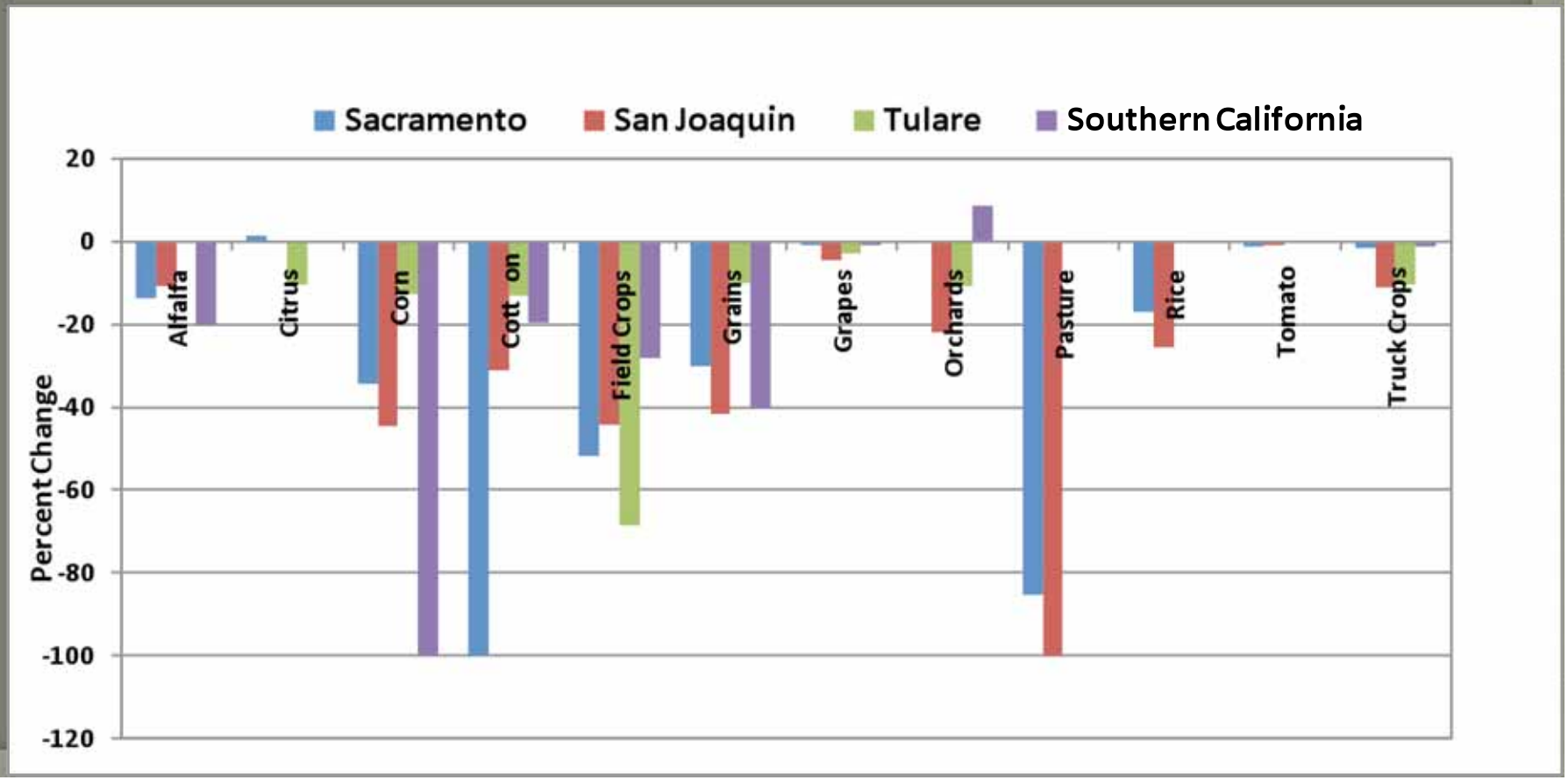
% Change in Available Water	Agriculture	Urban
Total	-25.7	-0.5

- Climate Induced Yield Change

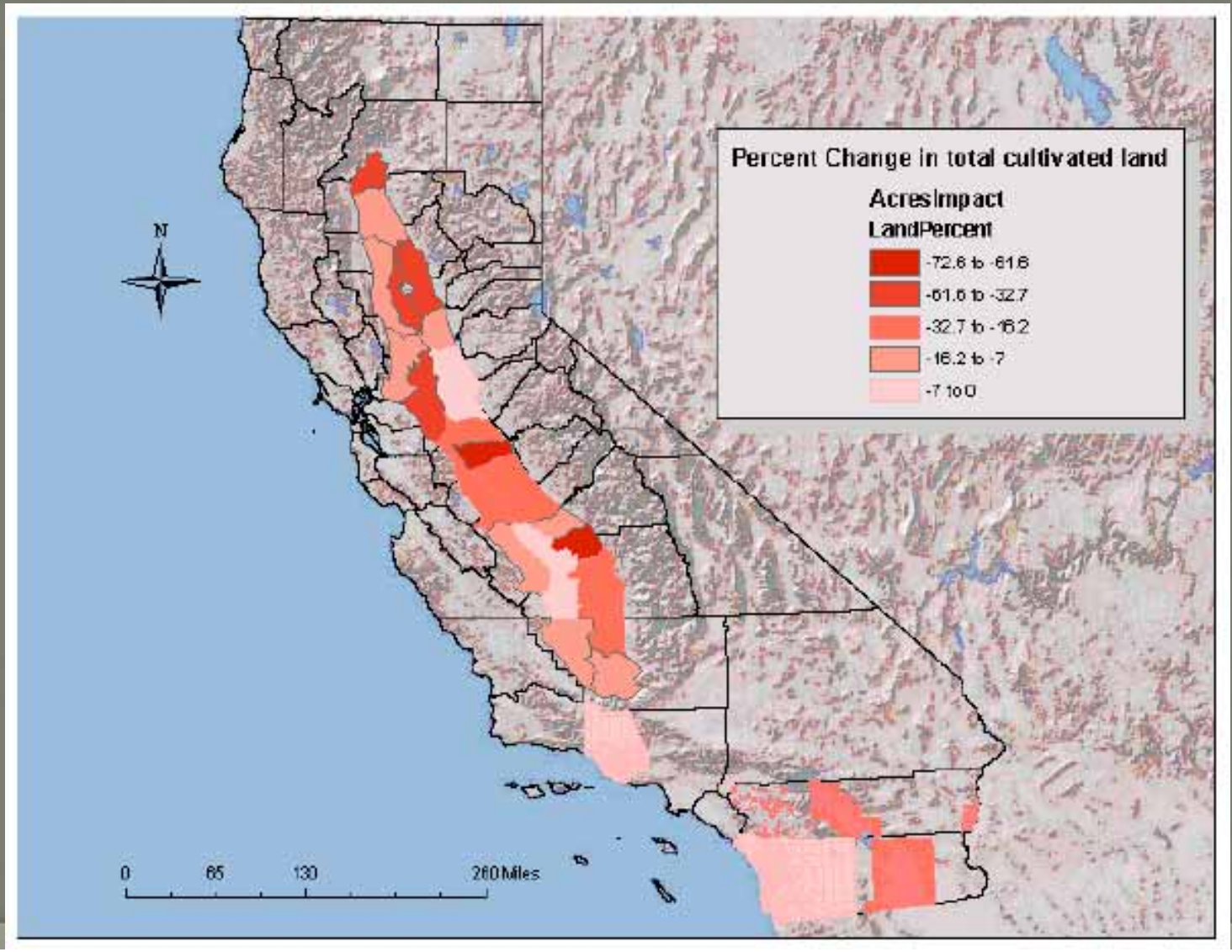
Crop Groups	Sacramento	San Joaquin
Alfalfa	4.9	7.5
Citrus	1.77	-18.4
Corn	-2.7	-2.5
Cotton	0.0	-5.5
Field	-1.9	-3.7
Grain	-4.8	-1.4
Orchards	-9.0	-9.0
Pasture	5.0	5.0
Grape	-6.0	-6.0
Rice	0.8	-2.8
Tomato	2.4	1.1
Truck Crops	-11.0	-11.0

Extensive Margin Results: Land Use Changes

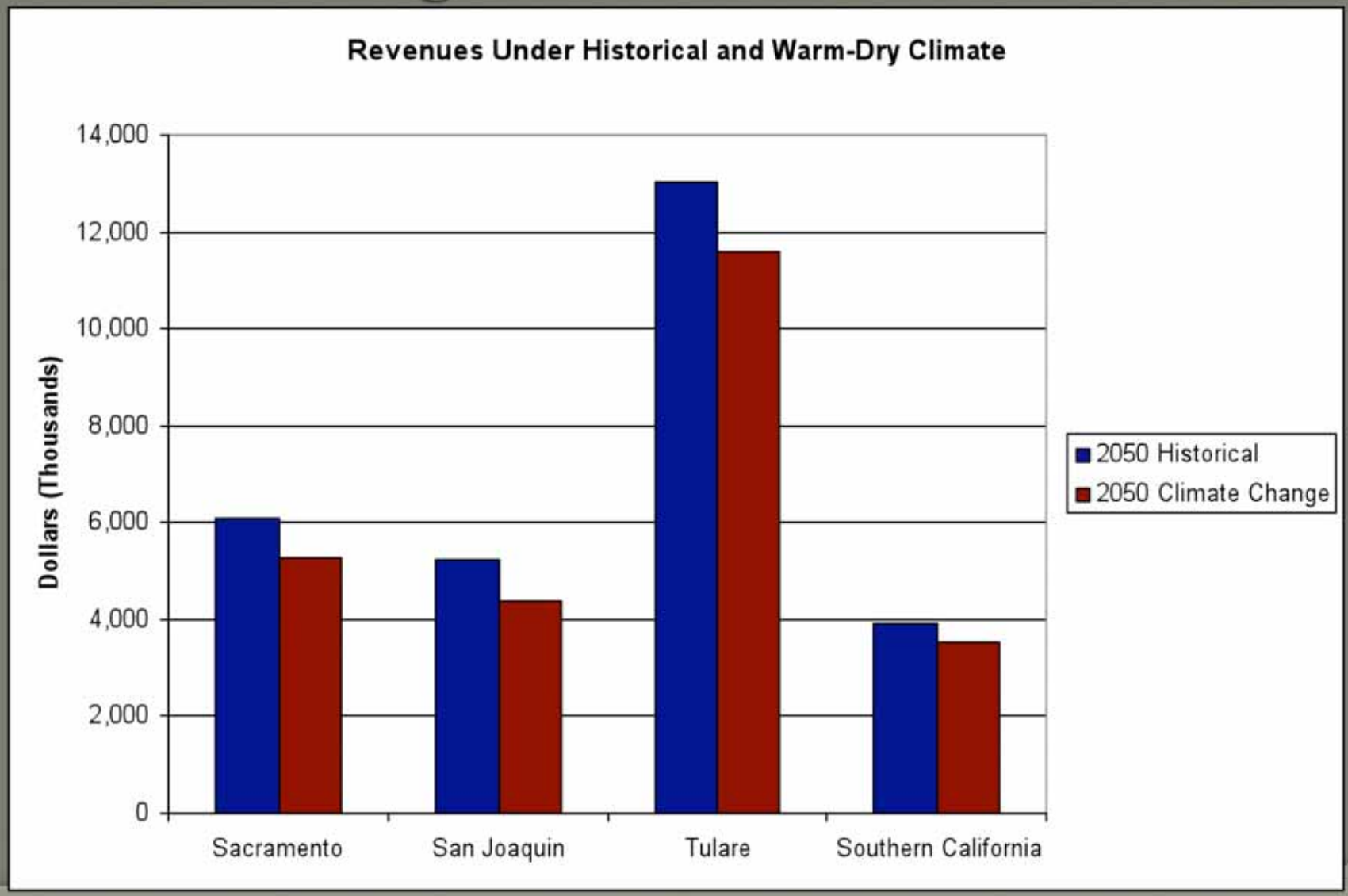
- Shift to less water intensive crops
- Production shifts to regions with comparative advantages



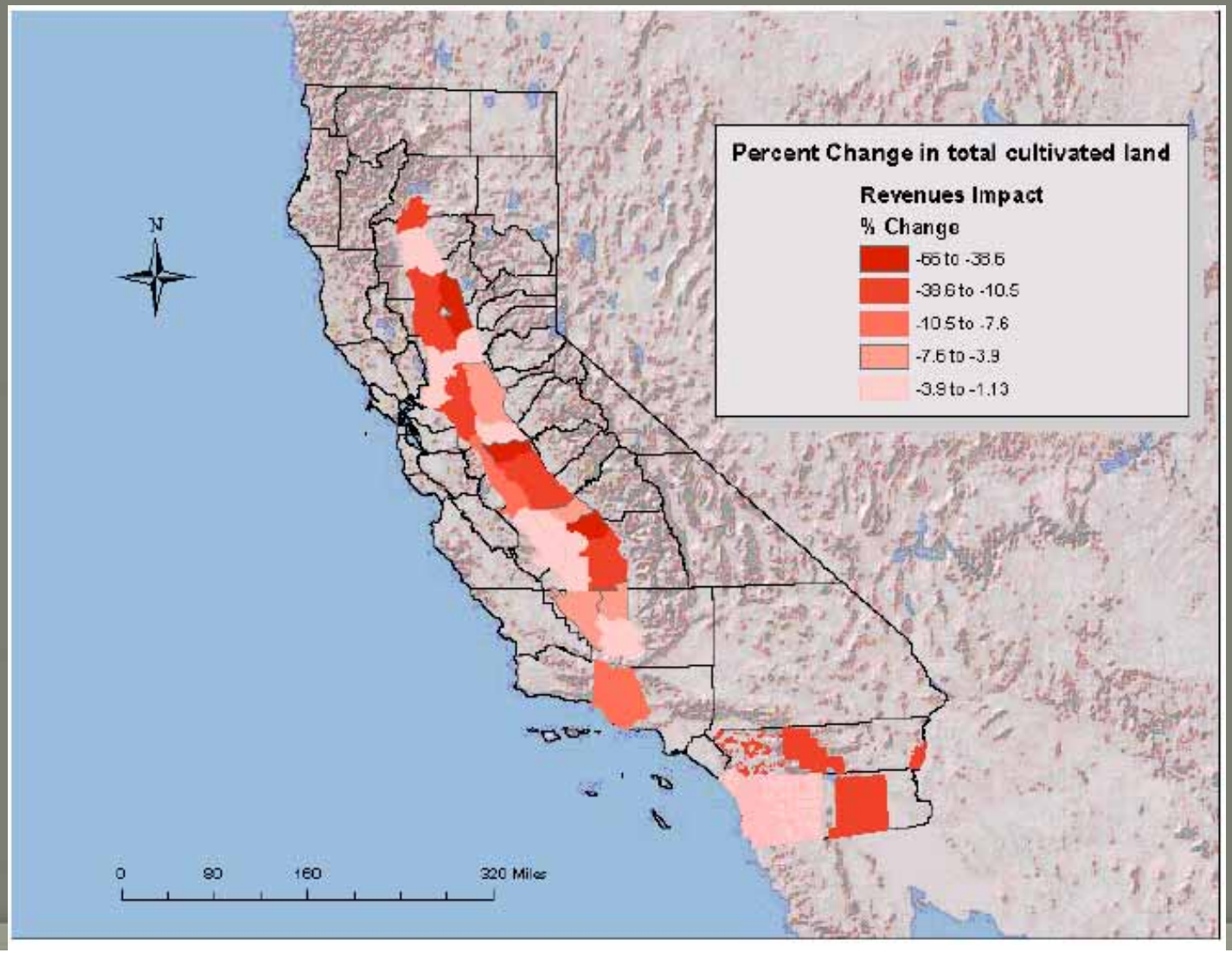
Land Use Changes with Climate Change



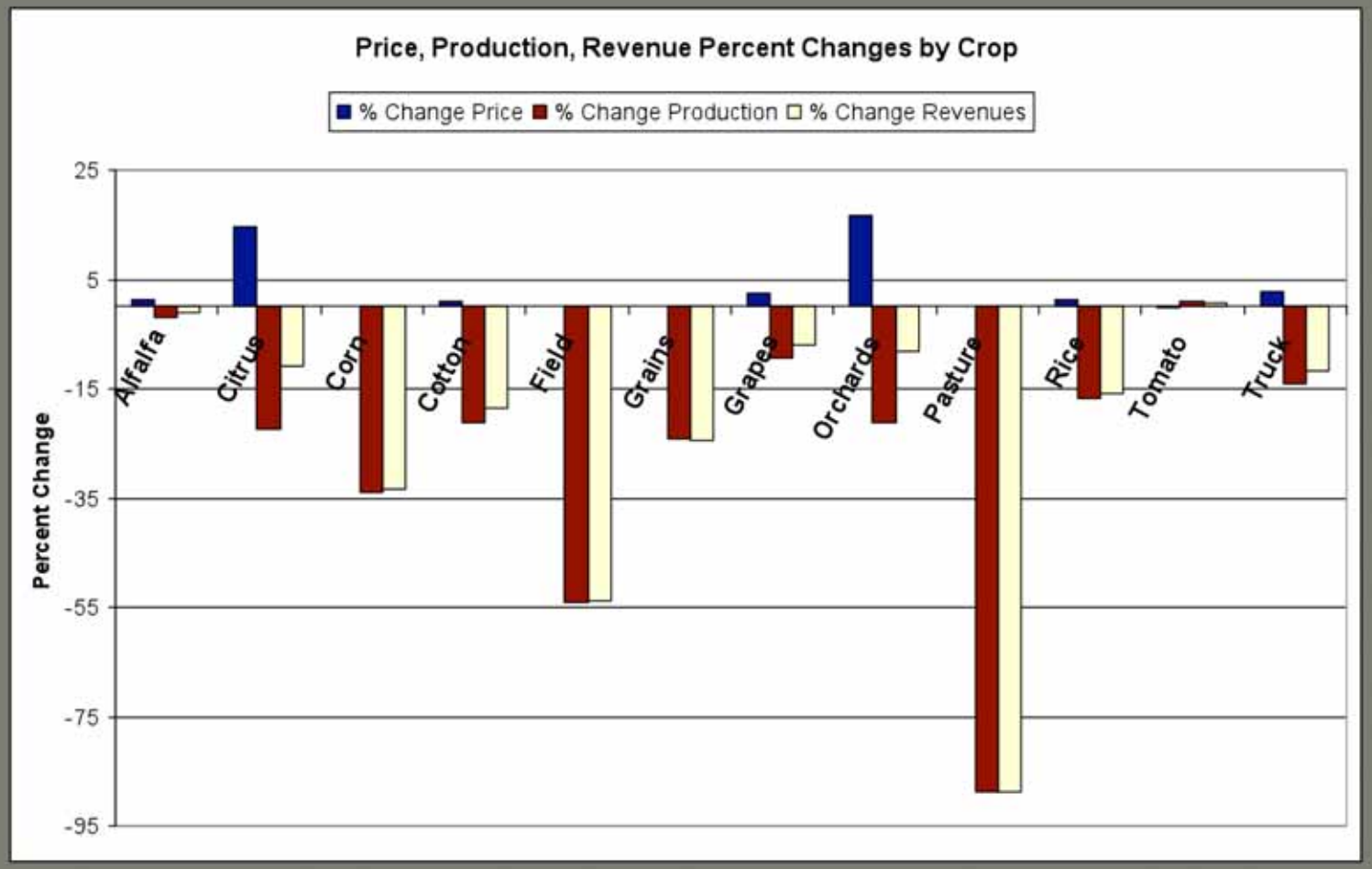
Extensive Margin Results: Regional Revenue Reduction



Change in Revenues with Climate Change

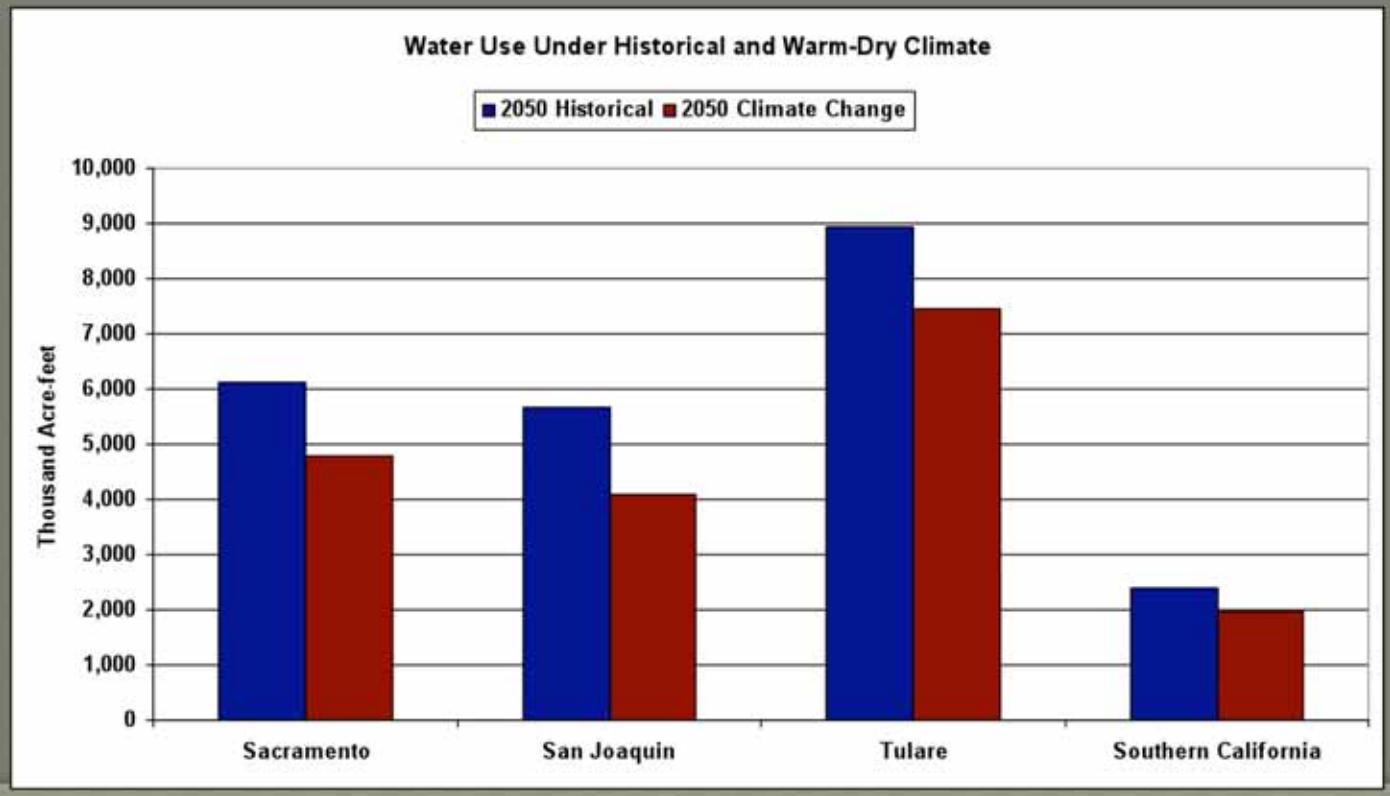


Extensive Margin Results: Crop Prices, Production, Revenues



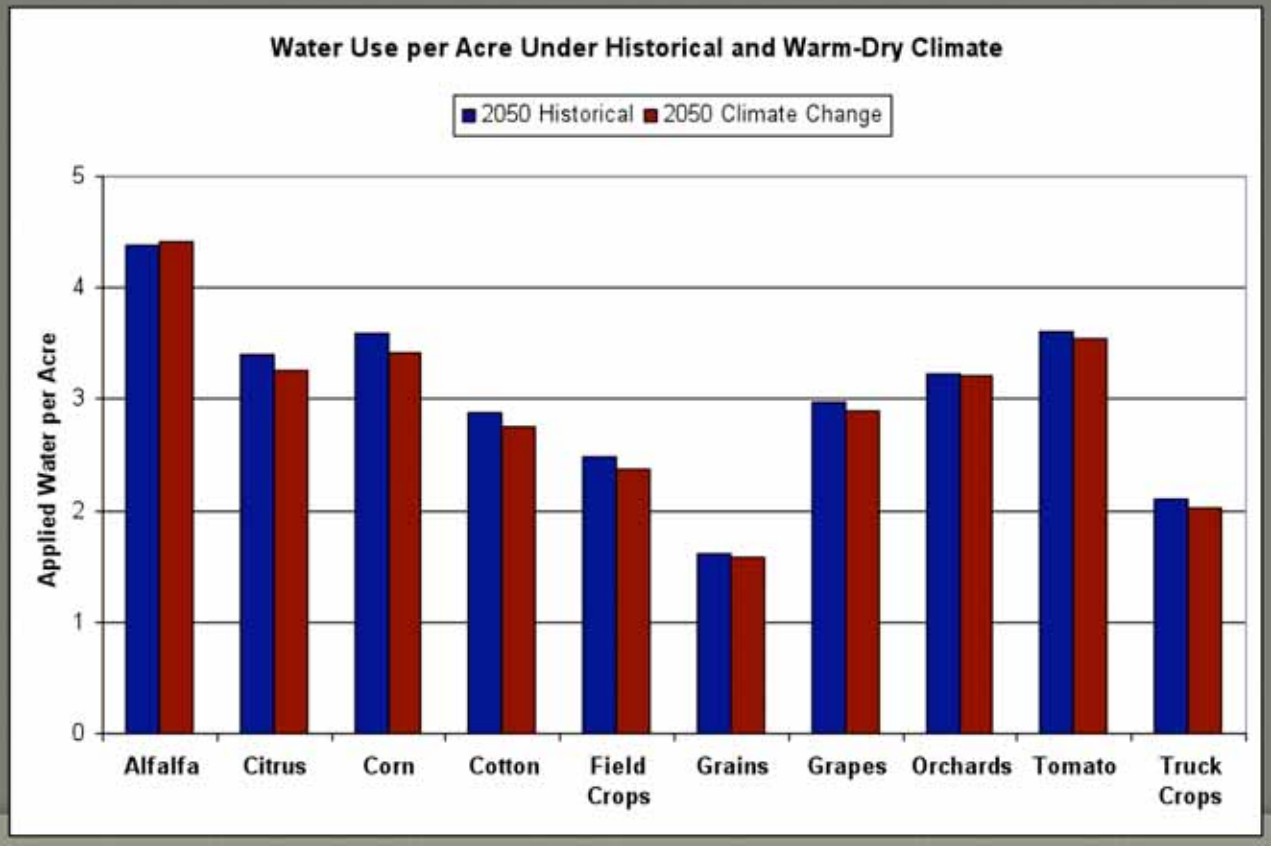
Extensive Margin Results: Regional Water Use

- Reduced water use across regions
  - Warm-dry climate water use from CALVIN allows for water transfers

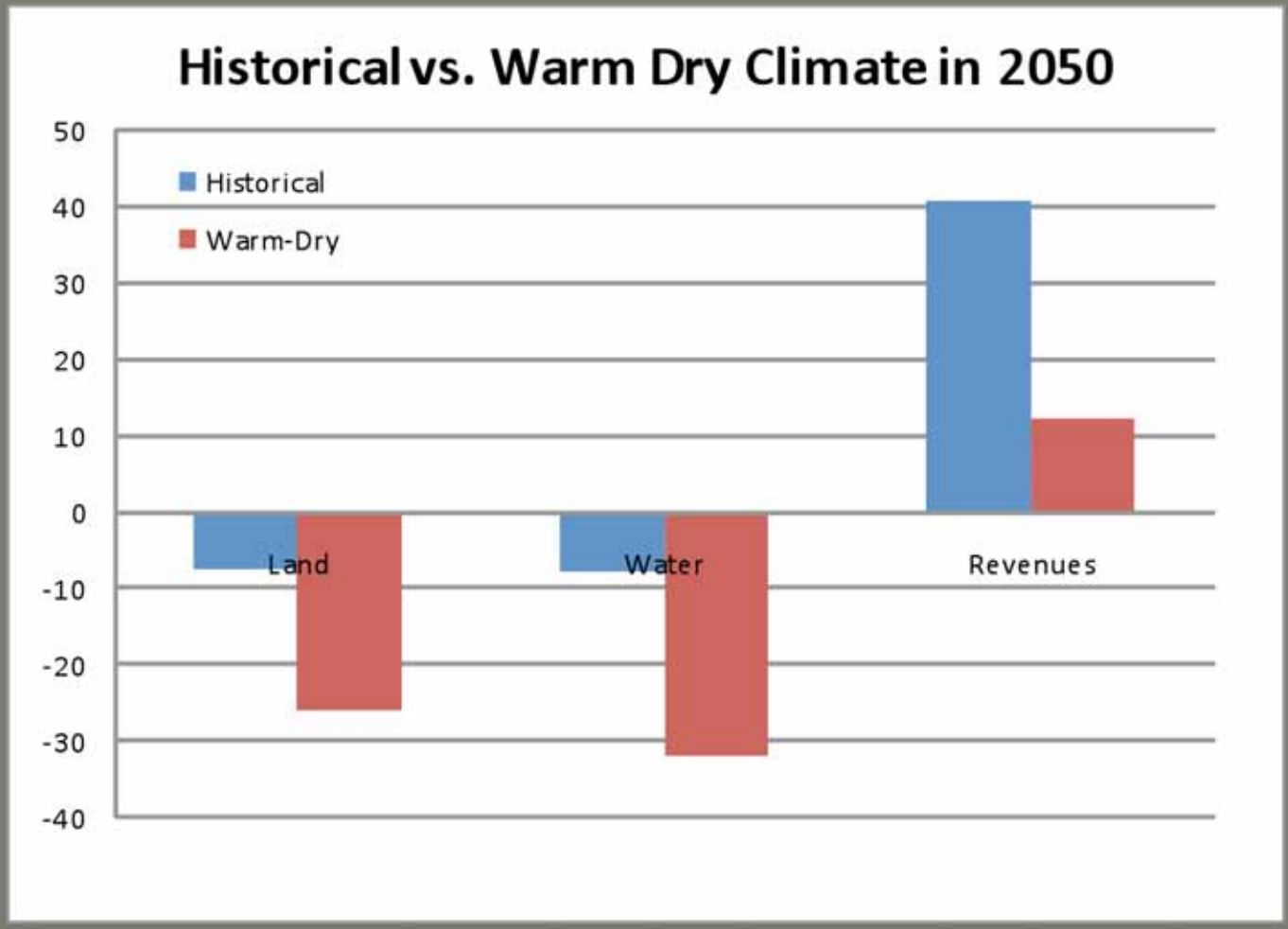


Intensive Margin Results: Water Use per Acre in CVPM 19

- Region 19 is in Kern County
- Farmers adjust water use per acre in response to reductions in available water and changing yields



Land, Water and Revenues 2050 versus 2005



Conclusions

- Both agronomic studies showed yield reduction in perennial and annual crops, with the exception of fodder crops.
- Both integrative studies found that water shortages will be the key resource through which climate change impacts will be felt in California
- Adaptation to climate change will depend on innovative research and resource management methods.
- Statewide acreage reductions average 20.5%
- 2050 agricultural revenues will increase over 2005 levels by 12.5% despite reductions in land and water use.